

Chapter Three- Research Methodology

3.1 Introduction

The previous chapter described innovation-related concepts such as innovation capability, innovation performance, and the related literature on theories as well as innovation research in Malaysia. It also highlighted the gap in the previous research, posed the research question, and presented the theoretical framework. The present chapter which you are about to read outlines the research methodology used to empirically address the research question of this study. This chapter consists of four sections including this introduction. Section 3.2 details the research design, which includes measurement instrument, sample selection. Section 3.3 details the statistical techniques employed in the research. And finally Section 3.4 presents the conclusion.

3.2 Research Design

Having identified the independent and dependent variables of the study and developed the theoretical framework, the next step is to design the research in a manner that the required data can be collected and analyzed to achieve the goal of the study. According to Sekaran (2003), this step involves a “series of rational decision-making choices (p.117)”. Issues such as study purpose, type of investigation, temporal aspects or time horizon, and the level at which the data will be analyzed (unit of analysis) are indispensable part of the research design (Sekaran, 2003).

As far as the level of sophistication and rigor of this study is concerned, it should be mentioned that the more sophisticated and rigorous the research design is, the greater the time, costs, and other resources expended on it will be (Sekaran, 2003, p. 118). Thus, as this project is a partial fulfillment of the MBA program at the University of Malaya, I had to questioned myself at every choice point whether “the benefits that result from a more sophisticated design to ensure accuracy, confidence, generalizability, and so on, would be commensurate with the larger investment of resources? (Sekaran, 2003, p.119)”. As a matter of fact, this mentality corroborates the notions of ‘marginal cost’ and ‘marginal benefit’ analysis which is so pervasive and ubiquitous in every aspect of our life be it social or academic. Therefore, I did my very best to ensure the professional quality of this study within the scope of tangible and intangible resources I had at my disposal.

The research design for this study is partly based on the theoretical framework which was originally developed by Terziovski (2007) and was presented in the previous chapter. The goal of the study is to determine *the key drivers of innovation within the firms located in Malaysia from a product and process innovation perspective*. It aims to establish the relationship between factors which are associated to innovation and that influence firm’s innovation performance.

Another issue of the design is the unit of analysis which refers to “the level of aggregation of the data collected during the subsequent data analysis stage (Sekaran, 2003, p.132)”. In this study, the problem statement focuses on key drivers of innovative organizations i.e. what are the main factors to turn an organization into an innovative organization. Therefore, in general ‘organization’ is the unit of analysis in this study. Accordingly, all the variables in the framework which make up the innovative organization

such as innovation capability, and innovation performance should be investigated in every sampled organization.

As far as time horizon is considered, this study can be considered among cross-sectional studies because the data are gathered just once, but over a period of almost four months starting from mid Feb and lasting until May 2010. Sekaran (2003, p.135) calls this type of studies as one-shot or cross-sectional studies. In what follows, the detailed analysis of the research design is presented.

3.2.1 Measurement Instrument (Questionnaire)

This research utilizes a quantitative survey research method. This design is preferred due to its advantages such as economy of design, the rapid turnaround in data collection, and the ability to identify attributes of a population from a group of individuals.

This study had been originally designed to employ the survey questionnaire which was based on Tidd, Bessant, and Pavitt's book of "Managing Innovation" (2005) which has been one of the leading textbooks in the field of innovation for consecutive years. However, as the researcher came across the research body conducted by Lawson and Samson (2001), and the work of Terziovski and Samson (2007) in the year 2009, there were minor changes in the direction of the study. These two studies, compared to Tidd et al. 2005, were more focused on exploring the relationship between a firm's innovation capability and its innovation performance. Therefore, having studied these papers in detail, and reflecting upon Terziovski's questionnaire, it was decided to adopt his questionnaire with the permission of the author for the purpose of replication. In fact, the questionnaire was asked for through e-mail correspondence. This was mainly due to three main reasons.

First and foremost, the reliability and validity of the instrument had been already established through his study as part of the ‘Australian Research Council Discovery Project’, therefore, there was a high probability of achieving an acceptable level of reliability and validity by employing the same questionnaire in Malaysia. Secondly, as innovation research is an under-researched area in Malaysia, the attempt to find and build upon an instrument which has been already tested and tried academically was unsuccessful, therefore, external assistance was needed. Lastly, most of the variables/constructs tested through Terziovski’s questionnaire were similar to the original thought and design of the researcher’s study, thus no major shift of original plan was necessary.

However, it was necessary to slightly modify the adopted questionnaire to make it fit the design and objective of this study. The original adopted questionnaire comprises 146 items (questions) excluding basic company data (questions on firm size, age, industry, etc) encompassing three main constructs (Enablers, Innovation Capability and Innovation Performance). Due to its length, and the fact that ‘Enablers’ has not been a focus in this study it was necessary to remove 37 items which belonged to this construct.

Data collection in this study was achieved through self-administered, structured questionnaires containing closed-ended questions. The survey questionnaire, hereinafter called Innovation Capability Survey (ICS), runs for 11 pages encompassing two major constructs of the present study; namely, *Innovation Capability* and *Innovation Performance* which are all measured on a five-point, Likert-type scale. The Likert scale is designed from negative to positive (e.g. ‘strongly disagree to ‘strongly agree’) and this order remains as it is, i.e. it remains as five-point scale to the end of the instrument. Nevertheless, it ranges in modes, i.e., it changes from ‘Strongly Disagree - Strongly Agree’, to ‘Very Ineffective-

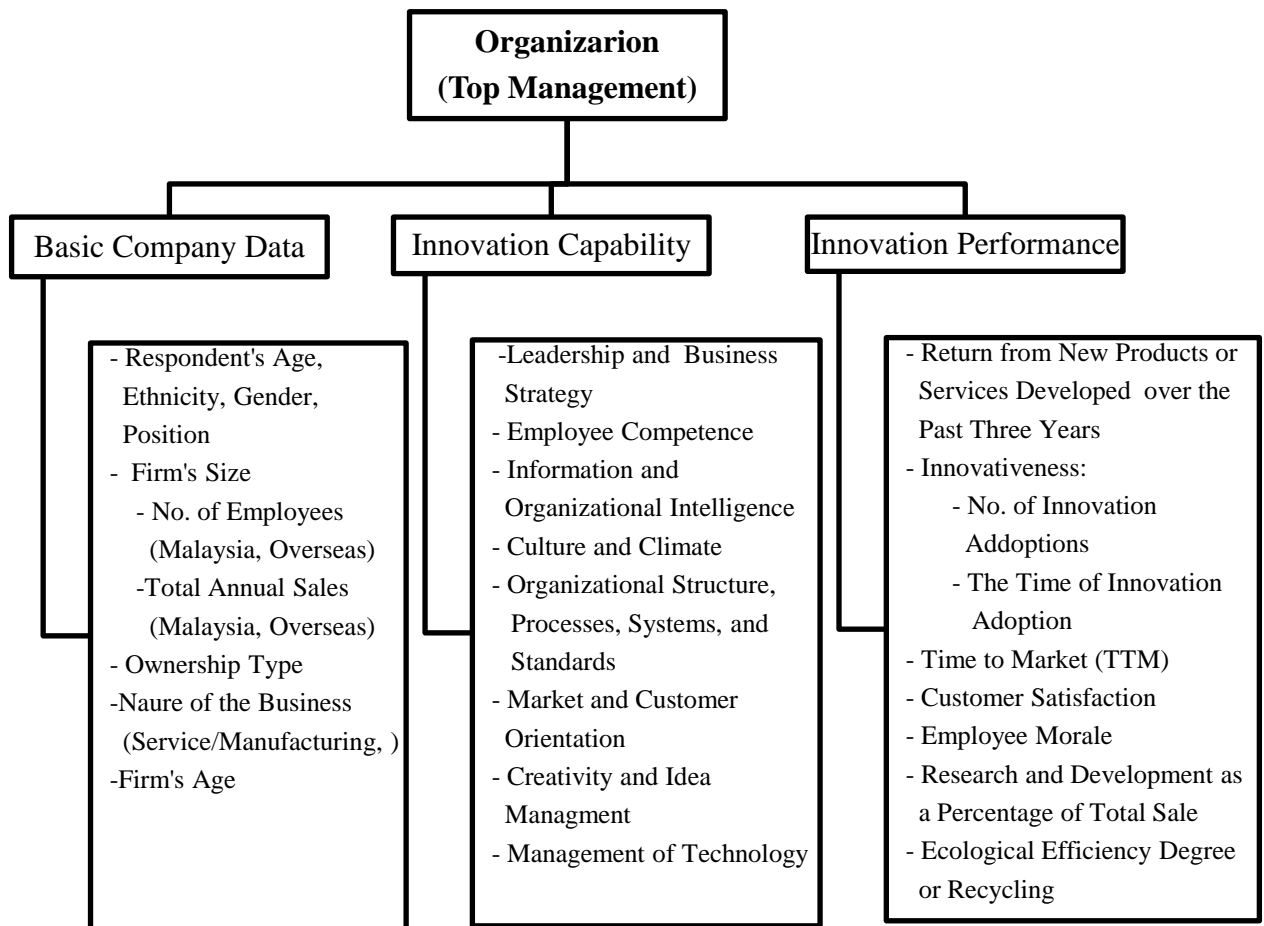
Very Effective’, or to ‘None at All- Extensive’, or to ‘Not at All- Full Extent’, and finally to ‘Not at All- Used a Lot’ as it best suits the question under investigation.

ICS has three main parts. The first part involves seven questions which are designed to elicit *Basic Company Data* such as number of employees, total annual sales, ownership type, nature of the business, etc. To answer this part, respondents are only required to make the minor effort of circling a number or a letter.

The second part covers the *independent construct* of the study which is *Innovation Capability*. This part is arranged in a way that it covers all sub-sections under Innovation Capability which includes Leadership, Employee Competence, Information and Organizational Intelligence, Culture and Climate, Organizational Structure, Processes, Systems and Standards, Market and Customer Orientation, Creativity and Idea Management, and finally Management of Technology. The third and the last part of the ICS elicits data on *Innovation Performance* and comprises eight items. Figure 3.1 graphically represents ICS (see Appendix 3: Questionnaire).

The major strengths of this survey are its information richness, full coverage of the related variables, and the simplicity of data elicitation. But, the major drawback is the length of it which by no means could be shortened. However, token of appreciation was used to improve the response rate and quality of the gathered data.

Figure 3.1: The Structure of Innovation Capability Survey (ICS)



3.2.2 Sample Selection

Selection of data resources is very critical to address the accuracy of the research objective. This study provides the first attempt to measure the key drivers of innovation performance in function of firm's innovation capabilities. The population selected includes all firms from different industries which are based and operating within the geography of Malaysia and more specifically located in the state of Selangor/ Federal Territory and Klang Valley.

This study adopts a critical case sampling (purposeful sampling) design that permits logical generalization and maximum application of information to other cases if it's true of

this one case (Taylor-Powell, 1998; Sekaran, 2003). That means through this design, the generalization of this study can be applied to other and wider population. This method is not new as it is widely adopted by market orientation research studies (Narver & Slater, 1990; Slater & Narver, 1993, 1995; Balakrishnan, 1996). Another chief reason the researcher chose this sampling method was the fact that in Malaysia, it is highly difficult to adopt random sampling based on company directories. The response rate after the first attempt based on email survey to randomly picked firms during the pilot study phase was '0'. Therefore, to ensure that this questionnaire survey is answered by the right respondents, the following steps were taken:

1. An Excel sheet containing all names, emails, and the telephone numbers of the personal/business/academic contacts of Assoc. Prof. S. Susela Devi (the thesis supervisor) and me, as the researcher was created. This Matrix includes:
 - Top managers, senior executives, government high ranks, and entrepreneurs holding top managerial positions who are considered as the potential respondents or are able to open doors to other qualified respondents through informant chaining.
2. Preliminary telephone calls were made to introduce the nature and purpose of the research and to ask for the potential respondent's permission to be included in the survey.
3. Following telephone conversations, if agreed, an email with enclosed questionnaire in both PDF format and Word Microsoft Office format (2003 and 2007 versions) was sent. All formats are required because if the respondents are willing to print the questionnaire, the PDF format protects the appearance of the

questionnaire and therefore the face validity of it will be preserved. Also, some may have not the latest version of the Microsoft Office and this will burden them or stop them from either replying the questionnaire or replying in an efficient and reliable manner.

4. Acknowledgment email was requested to make sure the respondents or links received the questionnaire.
5. Up to two follow-up phone calls or emails were made to persuade the collection of the sent questionnaires.

It should be noted that through these phone calls and contacts necessary meeting were arranged with instrumental companies and organizations such as SMECorp, Malaysia SME, Federation of Malaysian Manufacturers, etc to build networking for the purpose of data collection. Normally, if the CEO of these organizations agree, it would be easier to use their clout in order to persuade their association members to reply to the questionnaire.

The respondents of this study are mainly top managers; preferably, CEO, deputy CEO, CFO, CMO, etc because, our basic assumption is that people by right should possess the right amount of knowledge and experience pertaining to strategy, marketing, product and financial functions of the firm.

In some cases, the questionnaires were handed in to the respondents in the sample in person, and upon collection of the survey the respondent would receive a token of appreciation (a mechanical pen bearing the logo of University of Malaya). Additionally, many questionnaires reached the respondents through a third party in the form of business or academic links. A very marginal part of the respondents is the MBA/MM students of

University of Malaya who fulfill the criteria for selection, i.e. holding a top managerial position in their firms.

3.3 Statistical Techniques

Statistical techniques are the tools by which researchers analyze data, test research hypotheses, and subsequently refine theories. The characteristics of the data and the objective of the research determine the types of analysis that need to be conducted. In this study, Factor Analysis (FA) and Multiple Regression Analysis (MRA) are two main statistical techniques used to answer the research question.

3.3.1 Factor Analysis

Factor Analysis (FA), as posited by Tabachnick and Fidell (2007), is often used “when there is a theory about underlying structure or when the researcher wants to understand underlying structure (p. 26)”. Therefore, based on the literature proposed in Chapter 2 of this study, it is believed that a firm’s innovation performance is driven by its innovation capability, as a result, FA is useful in assessing this theory. However, as there is a large number of items (variables) on ICS it is necessary to summarize patterns of correlations among observed variables to reduce a large number of observed variables to a smaller number of factors, to provide an optional definition (a regression equation) for an underlying process by using observed variables. As the number of factors is usually far fewer than the number of observed variables, there is considerable parsimony in using factor analysis. (Tabachnick & Fidell, 2007)

In this study, Exploratory FA is performed because in the early stages of research, exploratory FA provides a tool for consolidating variables and for generating hypotheses about underlying processes. The main question in exploratory FA is: What are the underlying processes that could have produced correlations among these variables? Therefore, factors are thought to “cause” variables. The next step is to develop hypotheses and to test them in a follow up study (Tabachnick & Fidell, 2007). The following formula presents the generic equation of FA used in this study.

$$F_i = A_{ij} X_{ij}$$

Where F_i is the i th factor, A is the loading of the i th factor and j th variable and X_{ij} is the independent variable of the i th factor and j th level; Also where $i = 1, 2, 3, \dots, n$; and $j = 1, 2, 3, \dots, m$; where $i \neq j$.

3.3.2 Multiple Regression

Another statistical procedure used in this study is Multiple Regression Analysis (MRA). This is a statistical technique which allows the researcher to assess the relationship between one Dependent Variable (DV): Innovation Performance, and several Independent Variables (IVs): Innovation Capabilities. However, according to Tabachnick and Fidell (2007) “...regression analyses do not imply that the relationships are causal (p. 122)”. Therefore, MRA is used to identify the significant factors in the model that explain the bulk of the variance in innovation performance. The result of this analysis will be used to answer the single main question of this study: “*What are the key drivers of innovation within firms in Malaysia from a product and process innovation perspective?*” In addition, descriptive

statistics are used to analyze and interpret the statistical attributes of the population, sample and variables.

MR “is not just one technique but a family of techniques (Pallant, 2005, p.140)” that can be used to explore the relationship between one continuous DV and a number of IVs or predictors (usually continuous) (Pallant, 2005; Hair, Black, Babin, Anderson, & Tatham, 2006). It is actually “based on correlation”, but able to “allow a more sophisticated exploration of the interrelationship among a set of variables” (Pallant, 2005, p.140). This makes it ideal for the investigation of more complex real-life, rather than laboratory-based, research questions (Pallant, 2005, p.140).

In this research, Standard Multiple Regression Analysis is the main statistical technique used. It is one of the most extensively used multivariate statistical techniques for testing hypotheses and predicting values for dependent variables. In standard multiple regression all the independent (or predictor) variables are entered into the equation simultaneously. Each IV is evaluated in terms of its predictive power, over and above that offered by all the other IVs. Pallant (2005) believes that this is the most commonly used multiple regression analysis. So according to her, this approach can be used if we have a set of variables (e.g. various innovation capabilities) and want to know how much variance in the DV (innovation performance) they are able to explain as a group or block. Also, this approach would tell us how much unique variance in the DV is explained by each of the independent variables. (Pallant, 2005)

Moreover, attempts are made to allow discussion of the quantitative results of the analysis in light of the significance of beta coefficients entered into the model, rather than to

describe the accuracy and the fitness of the model. The generic form of a multiple linear regression is:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \dots + \beta_j X_{ij} + \varepsilon_i$$

where Y is the DV, X_{i1} ,, X_{ij} are the IVs, β is the constant, β_1, β_j are the regression coefficients, notation i refers to the i th case in the n sample of observations, and ε represents an error term (as cited in Dharmadasa, 2009).

The underlying assumptions of the linear regression, the linearity, normality and homoscedasticity will be tested in the continuous data used for the regression analysis. Linearity is the relationship between DV and IVs, representing the degree to which change in the dependent variable is constant across the range of values for the independent variable. Linearity is assessed by analyzing the scatterplots of the variables. If nonlinearity is detected a data transform technique is used to convert the data into linear format.

The most fundamental assumption in linear regression analysis is normality, which refers to the degree to which the distribution of data corresponds to a normal distribution (Hair et al., 2006). Normality can be checked using a box plot diagram and kurtosis and skewness testing. In this study the kurtosis and skewness are used to detect the normality of the variables. If non-normality is found, a data transformation technique is used to transform the data into normality.

Consistent variance of the error term is associated with homoscedasticity. Homoscedasticity assumes that the DV exhibits equal levels of variance across the range of predictor variables (Hair et al., 2006). Variability affects the standard error and makes

hypothesis testing either too stringent or too insensitive. The Levene's test is used to assess whether the variances are equal across any number of groups.

Multicollinearity, which refers to the relationship among the IVs, is another issue in assumption testing. According to Pallant (2005) multicollinearity exists if the IVs are highly correlated ($r=.9$ and above). This situation can be detected by analyzing variation inflation factors (VIFs) (as cited in Dharmadasa, 2009). A VIF value of 1.0 indicates that a variable is orthogonal to all other IVs, implying that no multicollinearity exists. However, a common rule of thumb to indicate the existence of multicollinearity is a VIF value of 10 or higher (Lomax, 1992).

3.4 Conclusion

This chapter outlined the research methodology used in this study. First, descriptions were presented on research design, measurement instrument, data collection, and sample selection. Later, the statistical techniques of the research were identified and discussed. The most appropriate techniques were identified as Exploratory Factor Analysis and Standard Multiple Regression Analysis. In the following chapter attempts will be made to provide an appropriate answer for the research question by analyzing the data, presenting the results followed by their interpretations.